COTTAGERS' SELF-HELP PROGRAM

ENRICHMENT STATUS OF LAKES

IN THE

SOUTHEASTERN REGION OF ONTARIO

1992

AUGUST 1992

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Report prepared by:

Water Resources Assessment Unit
Technical Assessment Section
Southeastern Region

AUGUST 1993

T A B L E   O F   C O N T E N T S

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Baptiste Lake Association
Bass Lake Cottage Association
Battersea-Loughborough Association
Big Rideau Lake Association
The Greater Bobs Lake Association
Bon Echo Provincial Park
Brule Lake - Mr. G. F. Carleton
Buck Lake Protective Association
Burridge Lake Cottage Association
Calabogie Lake Estates, Ltd.
Charleston Lake Provincial Park
Charleston Lake Ratepayers Association
Chimo Park Community Association
Chippego Lake - Mr. D. Buchan
Christie Lake Association
Crosby Lake Cottage Association
Crowe Lake Property Owners Association
Dalhousie Lake Association, Inc.
Davern Lake - Mr. R.S. Christy
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Diamond Lake Cottagers Association
West Devil Lake Property Owners Association
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Gananoque Lake Property Owners Association
Glanmire Lake Cottage Association
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Gunter Lake
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Indian Lake Cottage Association
Kennebec Lake Cottage Association
Lake St. Peter Rate Payers Association
Limerick Waterways Ratepayers Association
Little Silver Lake Property Owners Association
Lower Beverly Lake Protective Association
Mink Lake Betterment Association
Mississippi Lakes Betterment Association
Moira Lake Property Owners Association
Mosque Lake - Mr. J. O'Dette

INTRODUCTION

Water Quality and Lakefront Development

As a result of our geological legacy we are fortunate to have many hundreds or even thousands, of lakes. They are one of our most valuable natural resources. Because of this rich lake heritage, outdoor summer recreation and water have become almost inseparably linked. A primary example of this linkage is the summer cottage. Increasing amounts of leisure time combined with the easy accessibility of many lakes from urban centres of population have resulted in the development of their shorelines with summer cottages, permanent homes, campgrounds and vacation resorts.

Eutrophication

Shoreline development and the associated increases in recreational activities around lakes can threaten their water quality and alter the very feature that attracted people to them in the first place. One consequence of watershed or shoreline development is an increase in the rate of supply of plant nutrients, particularly phosphorus and nitrogen, to a lake. Phosphorus and nitrogen are fertilizers. They promote the production of aquatic weeds and algae. Algae are microscopic green plants. One type of algae, the phytoplankton, grow dispersed throughout the water

algae, the phytoplankton, grow dispersed throughout the water of a lake. Other types of algae grow attached to rocks, underwater plants and other submerged surfaces. Increased production of plants and algae give rise to increased productivity at all levels of the food chain up to and including fish. The nutrient enrichment of waters and the attendant increases in biological productivity are scientifically referred to as ***eutrophication.***

A certain amount of nutrient enrichment or *eutrophication* is beneficial. Aquatic plants and algae are absolutely essential to the proper functioning of a healthy and well-balanced ecosystem. They provide food and shelter for fish and other aquatic life and through the process of photosynthesis replenish the vital supply of oxygen in the water. However, from a recreational use perspective, *eutrophication* can be undesirable. Increasing levels of phytoplankton cause a lake to become progressively greener and more turbid. The increased turbidity results in a decline in water clarity while more nearshore weeds and algae interfere with swimming and boating. In a few cases, of extreme nutrient enrichment, algal blooms may occur. Algal blooms produce pea-soup scums on the surface that make a lake unsuitable for recreational activities, particularly those that involve body contact with the water such as swimming.

Algal blooms affect more than just the surface of the water. As the algae die, they sink and decompose. The decomposition uses up the limited supply of oxygen at the bottom of a lake. Deep water fish such as lake trout and other aquatic life that are found at the bottom of the lake are deprived of the oxygen they need in order to survive. In very shallow lakes, oxygen depletion seldom occurs because wind induced mixing and photosynthesis keep the water well oxygenated all the way to the bottom.

Sources of Nutrient Enrichment

Nutrients occur in a lake naturally. They originate in rainfall and melt-water runoff from the surrounding land, by resolublization from lake bottom sediments and by the fallout of dust and other particulates directly on the lake surface. The supply, however, is influenced by human activities. A major portion of the nutrient supply from land runoff results from erosion. Disturbances of the terrain or ground cover around the lake that exposes soil increases the supply of nutrients bound to sediments in surface runoff. The use of manure and artificial fertilizers in agriculture and for residential lawns and gardens also increases the supply of nitrogen and phosphorus in runoff to lakes well above normal levels.

A major potential source of nutrients as a result of shoreline development is from domestic sewage wastes.

Human and household sewage contain phosphorus and nitrogen. The most common form of sewage disposal in rural areas where cottage development occurs is a septic tank - leaching bed system. A leaching bed provides for an underground release of a liquid effluent. Although conventional septic tank - leaching bed systems are extremely effective at removing bacteria from sewage they are not always as effective in their ability to remove phosphorus and nitrogen. Nitrogen and phosphorus in a sewage effluent released from a leaching bed can travel through the soil or via groundwater to reach an adjacent lake or watercourse. Some of the nutrients in the effluent are absorbed by soil and removed through uptake by vegetation. The degree of removal is highly variable. It depends on the type of soil, the depth to the water table, the nature of the bedrock, the amount of vegetation and the distance of the leaching bed from the lake. In some situations, especially for shoreline development on the sandy textured and porous soils of the PreCambrian shield, phosphorus and nitrogen from sewage systems reach the lake.

Limitations for Shoreline Development

Some lakes are naturally productive of weeds and algae. Even the best land use planning and lake management practices will not eliminate water quality problems associated with *eutrophication*. In other lakes, the growth of weeds and algae can be controlled by limiting the supply of phosphorus, nitrogen and other wastes reaching a lake. In the forested

and sparsely populated PreCambrian regions that make up most of cottage country, one of the more obvious controllable sources of nutrients are those associated with shoreline development. On certain, sensitive lakes, restrictions and controls on development are necessary.

LAKE SURVEYS AND WATER QUALITY MONITORING

Baseline Water Quality Surveys

In 1970 the Province initiated a comprehensive lake water quality survey program. Detailed baseline studies were carried out to inventory the physical, chemical and biological characteristics of our lakes with special emphasis on defining their sensitivity to nutrient enrichment. Over 300 lakes were surveyed in the Southeastern region of the province alone. The southeastern region includes Prince Edward and Hastings Counties and extends eastward to the Ontario - Quebec border (figure 1). It encompasses an area of 35,523 square kilometres and contains a population of 1.2 million.

Most of the surveyed lakes were found to have excellent water quality. Continuing surveillance is necessary to maintain a current record of the water quality of our lakes and to define and understand any changes or trends if they are developing.

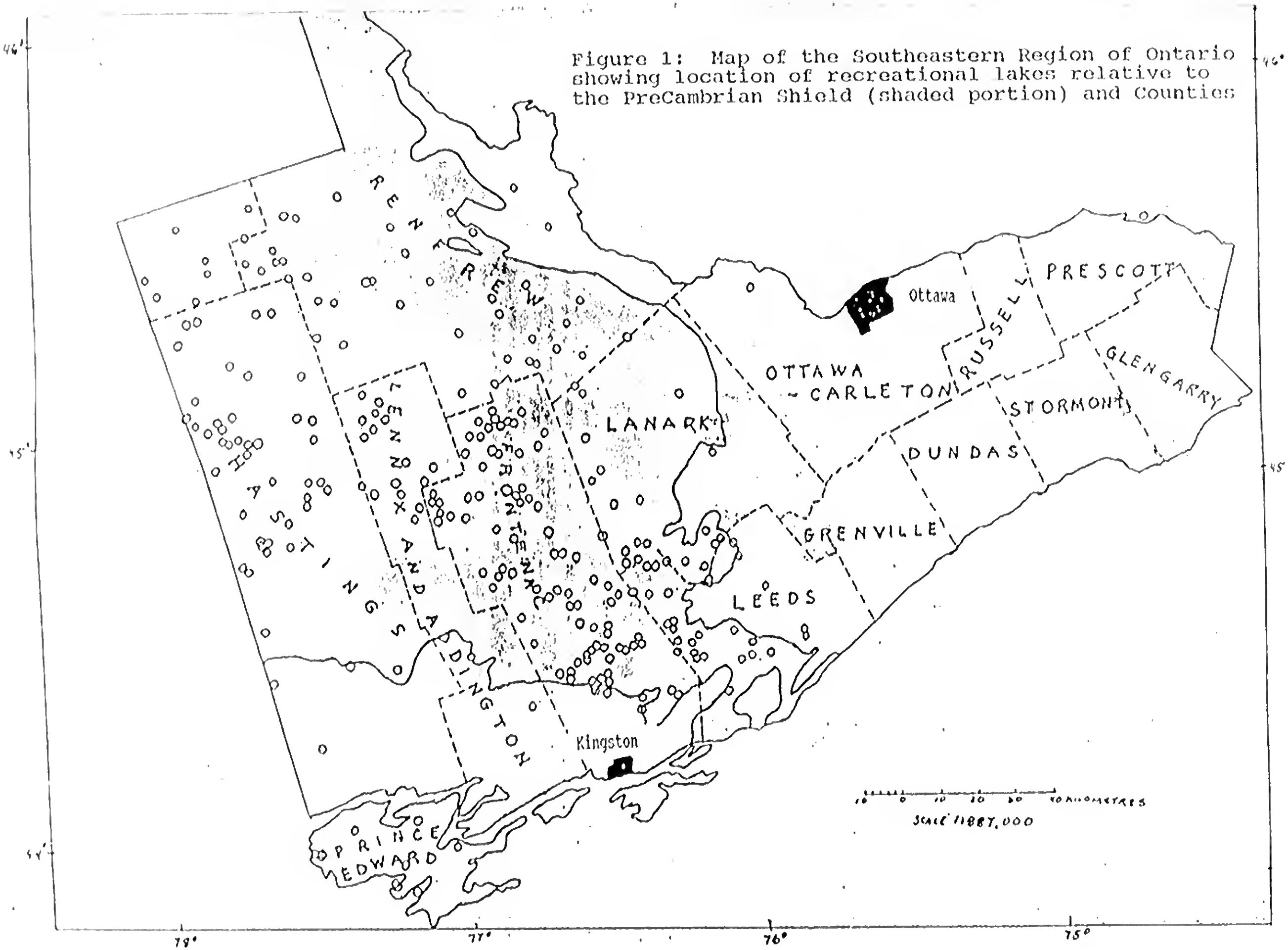

Figure 1: Map of the Southeastern Region of Ontario showing location of recreational lakes relative to the PreCambrian Shield (shaded portion) and Counties

Self-Help Lake Water Quality Monitoring Program

The Ministry of the Environment and Energy has neither the staff nor the resources to monitor the water quality of even a fraction of the lakes in the Province. Therefore, a "self-help" program was established to obtain the assistance of lake associations, individual cottagers and other waterfront property owners with this undertaking. Participants in the Self-Help Program dedicate a half hour or so of the time they are at their lake to make a measurement of water clarity and to collect a sample of water every week or two and arrange for its delivery to a Ministry of the Environment and Energy laboratory. The Ministry of the Environment and Energy analyzes the samples for their algae content, compiles the data and interprets the results.

METHODS

Sampling Equipment and Sample Delivery Arrangements

Volunteers participating in the Self-Help Program are provided with a Secchi disc and other necessary sampling equipment, a detailed set of sampling instructions, sample submission forms and return shipping material by the Ministry of the Environment. Arrangements are made for the cost of shipping water samples to be charged to the Ministry. In this way there is no direct out-of-pocket expenses incurred by the participants.

Secchi disc visibility depth measurements

Each volunteer is asked to make water clarity measurements at a single sampling location at a central or open-water area of their lake well removed from any localized shoreline influence. Water clarity measurements are made with a Secchi disc. A Secchi disc is a circular plate 20 cm in diameter that is painted with black and white opposing quadrants (figure 2). The depth at which it disappears from view when lowered over the side of a boat into a lake is a standard and widely used measure of water quality. It is obviously one half the distance light travels through the water to the disc and back to the observer's eye. The depth of effective light penetration into the lake can therefore be approximated as twice the Secchi disc visibility depth. The region from the surface of the lake to the lower depth of effective light penetration is referred to as the ***euphotic*** zone. There is just sufficient light at the bottom of the *euphotic* zone to sustain photosynthesis and allow aquatic plants and algae to grow.

Water sample collections

A sample of water is collected at the same time and place as each water clarity measurement for determination of the amount of algae in the lake. The Secchi disc visibility reading is used to determine the lower limit of the ***euphotic*** for the purpose of collecting the sample. The water sample

The "Secchi Disc Reading" is obtained by averaging the depth at which a 20cm (8") dia. black and white plate, lowered into the lake just disappears from view and the depth where it reappears as it is pulled up.

Most of the free-floating algae are suspended in the illuminated region between the lake surface and 2 times the Secchi disc reading.

Clear, algae-free lake: Secchi disc readings tend to be greater than 3m (9 feet).

Turbid or algae-rich lake: Secchi disc readings tend to be less than 3m (9 feet).

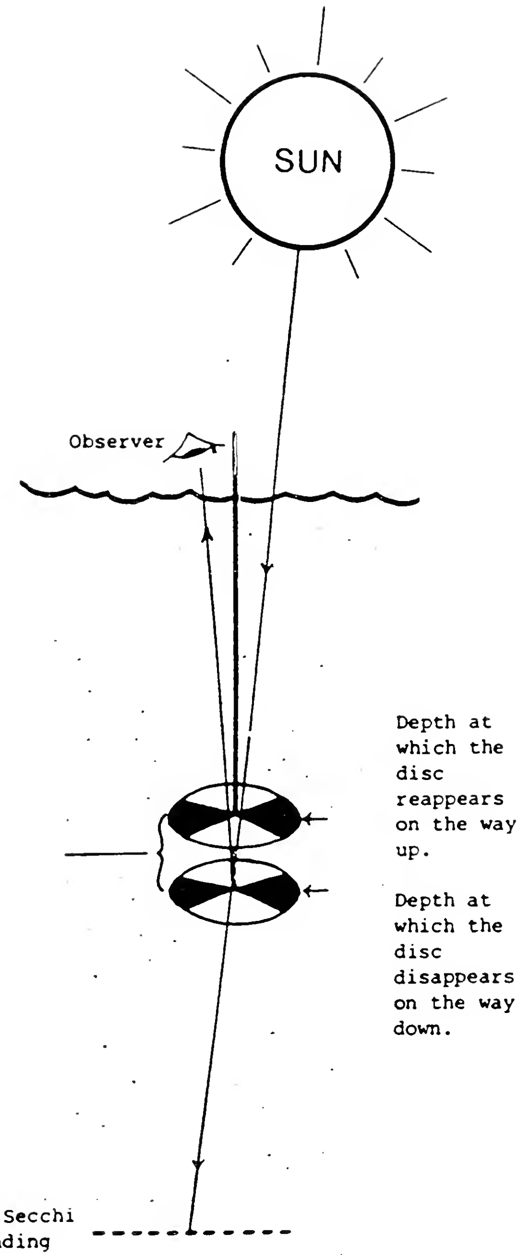

Figure 2: Diagram illustrating the use of a Secchi disc to measure water clarity.

is collected by lowering a bottle with a restricted opening in a weighted container to twice the Secchi disc visibility depth and raising it at a uniform rate so that it is just full or almost full when it reaches the surface. In this manner, a vertical composite sample equally representative of all levels of the *euphotic* zone is obtained. The water sample is preserved immediately after collection with 0.5 ml (five drops) of a one half per-cent magnesium carbonate suspension to prevent the degradation of chlorophyll pigment and forwarded, usually within a day or two, to the Ministry of the Environment and Energy.

Ancillary Observations

Each sample is returned with a submission sheet which identifies the lake, location, and the date and time of the sample collection. The sample submission sheet is used to record the Secchi disc visibility depth measurement, the weather and other observations that might assist with the interpretation of the results or to account for any anomalies in algal populations or water clarity caused by wind drift or other environmental factors.

Chlorophyll concentration determinations

The water samples are filtered using a 1.2 micron millipore filter. The residue is extracted with acetone and the chlorophyll concentration determined spectrophotometrically

according to standard methods of the Ministry of the Environment and Energy. Chlorophyll is a green pigment found in all plants including algae. The concentration of chlorophyll in a sample of water is a chemical measure of the amount of algae present in the lake at the time of sampling.

RESULTS

Self-help program participation

In 1992, one hundred and thirty seven volunteers sampled a total of 114 separate locations on 97 different lakes in southeastern Ontario. A total of 1298 samples were received averaging just over 13 samples per lake. A number of lakes were represented by more than one sampling location. This is necessary for lakes that are divided into two distinct bodies of water such as Buck, Loughborough, or Moira and desirable for complex lakes that are comprised of a number of separate basins such as Baptiste, Big Rideau and Bobs which may act independently from a water quality point of view.

Of the 97 lakes enrolled in the 1992 program, 89 were carried over from 1991, 5 were reintroductions after an absence during the previous year(s), while 3, Frost, Lavallee and Little Crosby Lakes were new to the program in 1992.

Individual lake reports and tabular summary of results

The results of the Secchi disc visibility depth measurements and chlorophyll concentration determinations for all 114 sampling locations on the 97 lakes are summarized as seasonal mean values in Table 1. Separate results for each sampling date are provided as a series of individual lake data printouts which are being distributed along with this report. In addition to the current year's data, the individual lake data printouts contain a table of Secchi disc reading and chlorophyll concentration means for previous years. The record of previous mean values are provided to facilitate a comparison with the measurements made in 1992.

Lake Variability

Chlorophyll concentrations and water clarity may vary considerably at a given location from one sampling date to the next and over the growing season. It is not unusual for the maximum chlorophyll concentration to exceed two or three times the seasonal average. Unless a sampling program of sufficient frequency and duration to encompass any variability has been undertaken, a single statistic such as a sample mean may not be entirely representative of a lake's condition. Ideally, 12 or more observations at regular intervals from the end of May to the beginning of October (for example, the Victoria Day weekend to the Thanksgiving

Table 1: Mean chlorophyll concentrations (ug/L) and Secchi disc visibility depths (m) 1992

LAKE	COUNTY	CHLOR	SECCHI	NOTE
ADAM	LANARK	3.0	3.2	
ALBION	HASTINGS	1.7	3.7	1
ASHBY	LENNOX & ADD.	1.2	5.2	1
BAGOT LONG	RENFREW	10.5	4.4	1
BAPTISTE	HASTINGS	1.6	4.3	
BASS	LEEDS	1.3	4.5	1
BEAVER - SOUTH BASIN	LENNOX & ADD.	2.8	1.4	
BIG CLEAR	FRONTENAC	1.3	4.0	
BIG GULL (CLARENDON)	FRONTENAC	1.9	4.7	
BIG RIDEAU	LANARK, LEEDS	2.1	4.4	
BIG RIDEAU - BRITON BAY	LANARK, LEEDS	2.0	5.0	
BLACK	LANARK	3.9	3.9	
BLACK DONALD	RENFREW	1.3	6.3	
BOBS - CROW BAY	FRONTENAC	2.1	4.3	1
BOBS - EAST BASIN	FRONTENAC	3.2	3.9	
BOBS - GREEN BAY	FRONTENAC	1.5	3.8	1
BOBS - MUD BAY	FRONTENAC	3.9	3.4	
BOBS - WEST BASIN	FRONTENAC	2.5	3.7	
BOULTER	HASTINGS	1.3	3.2	
BRULE (WENSLEY)	FRONTENAC	1.3	7.2	
BUCK - NORTH BAY	FRONTENAC	2.0	4.9	
BUCK - SOUTH BAY	FRONTENAC	3.1	5.8	
BURRIDGE	FRONTENAC	2.3	4.6	
CANONTO	FRONTENAC	6.4	9.5	1
CASHEL	HASTINGS	1.1	5.3	
CHARLESTON - BIG WATER	LEEDS	3.0	3.9	
CHARLESTON - GOOSE ISLAND	LEEDS	3.2	3.8	
CHARLESTON - WESTERN WATER	LEEDS	3.6	3.8	
CHIPPEGO	FRONTENAC	3.5	3.6	
CHRISTIE	LANARK	4.3	4.4	
CLEAR	RENFREW	0.8	6.7	1
COLE	FRONTENAC	9.8	2.4	1
COLLINS - NORTH BASIN	FRONTENAC	4.6	2.8	
COLLINS - SOUTH BASIN	FRONTENAC	3.2	2.8	
COPELAND	LENNOX & ADD.	1.8	5.7	1
CROSBY (BIG CROSBY)	LEEDS	2.8	4.5	
CROW	FRONTENAC	1.8	5.0	1
CROWE	HASTINGS	3.7	2.1	
DALHOUSIE	LANARK	1.7	3.8	
DAVERN	LANARK	3.6	5.2	
DEMPSEY (VIRGIN)	RENFREW	2.3	5.5	
DESERT	FRONTENAC	2.1	5.0	
DEVIL	FRONTENAC	1.5	5.3	
DIAMOND	HASTINGS	3.3	5.5	

LAKE	COUNTY	CHLORO	SECCHI	NOTE
DICKEY - NORTH BASIN	HASTINGS	1.6	4.2	
DICKEY - SOUTH BASIN	HASTINGS	1.4	4.7	
EAGLE	FRONTENAC	2.1	5.7	
ELBOW	FRONTENAC	4.1	3.7	
FARREN (FARRELL)	LANARK	1.7	5.3	
FROST		1.2	1.5	1
GANANOQUE	LEEDS	7.1	2.2	
GRIPPEN	LEEDS	4.1	2.7	1
GUNTER	HASTINGS	1.1	4.3	1
HAY	NIPISSING	2.7	1.9	
HAY BAY	LENNOX & ADD.	11.2	1.9	
INDIAN	LEEDS	2.4	3.6	
INVERARY	FRONTENAC	13.1	1.7	1
JEFFREY	HASTINGS	1.5	3.9	
JEFFREYS (OLMSTEAD)	RENFREW	1.5	5.8	
JOEPERRY	LENNOX & ADD.	2.0	3.5	
KASHWAKAMAK	FRONTENAC	2.1	2.8	1
KILLENBECK	LEEDS	8.2	2.5	
LAVALLEE	HASTINGS	0.8	4.6	1
LIMERICK	HASTINGS	1.6	5.2	
LITTLE CROSBY	LANARK	2.8	4.5	
LITTLE SILVER	LANARK	1.3	4.4	
LOUGHBOROUGH - EAST BASIN	FRONTENAC	4.3	3.3	1
LOUGHBOROUGH - WEST BASIN	FRONTENAC	3.1	4.7	1
LOWER BEVERLY - OAK BAY	LEEDS	12.7	1.7	
LOWER HAY	NIPISSING	2.3	3.1	
MACKIE	FRONTENAC	1.2	7.2	
MAZINAW	LENNOX & ADD.	1.1	4.8	
MCKENZIE	NIPISSING	1.2	4.5	1
MEPHISTO	HASTINGS	1.0	5.4	
MINK	RENFREW	1.8	3.8	
MISSISSIPPI	LANARK	3.5	3.9	
MOIRA - EAST BASIN	HASTINGS	10.5	2.1	
MOIRA - WEST BASIN	HASTINGS	7.4	1.9	
MOSQUE - NORTH & SOUTH	FRONTENAC	1.2	4.9	
MOSQUE - WEST BASIN	FRONTENAC	3.3	3.8	
MUSKRAT	RENFREW	2.0	4.1	
NORWAY	RENFREW	1.2	5.2	
OAK HILL	HASTINGS	1.0	5.9	1
OPINICON	LEEDS	3.4	3.2	
OTTER	LEEDS	1.6	4.2	
OTTER - NORTH BASIN	FRONTENAC	2.5	4.1	
OTTER - SOUTH BASIN	FRONTENAC	3.0	3.3	
OTTY	LEEDS	1.8	3.9	
PAUGH	RENFREW	1.1	5.0	
PEARKES	FRONTENAC	2.1	3.9	
PIKE	LANARK, LEEDS	2.6	4.3	
RED HORSE - EAST BASIN	LEEDS	4.1	3.6	

LAKE	COUNTY	CHLOR	SECCHI	NOTE
RED HORSE - WEST BASIN	LEEDS	5.8	3.5	
ROBERTSON	LANARK	0.7	6.8	
SAINT ANDREW	FRONTENAC	4.9	3.1	
SAINT PETER	HASTINGS	1.3	4.1	
SALMON TROUT	HASTINGS	5.4	3.6	
SAND	LEEDS	2.3	4.7	
SHABOMEKA	FRONTENAC	2.3	5.8	
SHARBOT - EAST BASIN	FRONTENAC	2.8	4.6	
SHARBOT - WEST BASIN	FRONTENAC	3.9	4.8	
SHAWENEGOG	FRONTENAC	4.3	5.8	
SILVER	FRONENAC, LANARK	2.4	3.6	
SKOOTAMATTA - WEST BASIN	LENNOX & ADD.	1.3	3.9	
STEENBURG	HASTINGS	3.2	4.6	
STOCO	HASTINGS	7.8	2.0	
STONES	RENFREW	1.6	3.5	
TROY	HASTINGS	6.6	1.9	
TWIN SISTER - EAST BASIN	HASTINGS	2.6	2.9	
TWIN SISTER - WEST BASIN	HASTINGS	2.4	4.1	
UPPER RIDEAU	LEEDS	4.1	2.8	
WESTPORT SAND	LEEDS	3.7	3.6	1
WHITE	LANARK, RENFREW	2.8	3.8	
WOLFE	FRONTENAC	1.3	7.6	

Note 1: The means of these lakes may not necessarily reflect their water quality as they are based on less than 6 sets of measurements.

weekend) should be collected. This is not always possible, depending upon a sampler's availability at the lake, and in many cases the data for a given lake represent conditions during the summer months only. Some discretion should be exercised in making comparisons between lakes and from one year to the next. Averages that were derived from less than 6 sets of observations are noted in the summary table and should be excluded from any type of comparative data analysis.

Secchi disc visibility depths

In the absence of highly coloured water or inorganic turbidity, Secchi disc visibility depends primarily on the amount of algae or phytoplankton in the water. Lakes with extremely low levels of algae are exceptionally clear and have high Secchi disc visibility depths. Lakes with high levels of algae are usually green or turbid by comparison and have low Secchi disc readings.

For example, in the clear and algae free waters of Brule and Mackie Lakes, the Secchi disc visibility routinely exceeded 7 metres. On the other hand, during periods of extremely high algal productivity experienced in the east basin of Moira Lake, Oak Bay of Lower Beverly Lake and Hay Bay, the visibility fell below 1.5 metres. Most lakes had an average Secchi disc visibility depth between 3.5 and 4.9 metres

during 1992 while the overall average for the 114 sampling locations listed in table 1 was 4.1 metres.

Secchi disc visibility depth is only an approximate measure of biological productivity. It is influenced by other factors. These include the amount of sunlight when the reading is taken and the eye sight of the observer taking the reading. Secchi disc measurements are made principally to determine the depth of the *euphotic* zone for the purpose of collecting water samples for chlorophyll analyses. Chlorophyll is a more direct and practical measurement of algae and hence ***eutrophication*** than water clarity. When chlorophyll concentrations are combined with Secchi disc visibility depth measurements a good assessment of a lake's *trophic* condition can be made.

Chlorophyll concentrations

In general chlorophyll concentrations were low during 1992. The average concentration ranged from 0.7 ug/L (micrograms per litre) for Robertson Lake to 12.7 ug/L for Oak Bay of Lower Beverly Lake. The majority of sampling locations had an average that fell between 1.6 ug/L and 3.5 ug/L while the overall average for the 114 waterbodies reported in table 1 was 3.1 ug/L.

In contrast to the general situation, a few lakes experienced peaks in chlorophyll concentrations exceeding 20 ug/L.

Depending on the lake, the peaks lasted from a few days to several weeks. In practical terms, water use impairment is more directly related to these peaks in chlorophyll concentration than to the annual or seasonal average concentrations. They may have interfered with the recreational use and enjoyment of those lakes, especially for activities that involve body contact with the water such as swimming.

Yearly Variability in Weather and Effect on Lake Productivity

No one who owns a cottage needs to be reminded how wet, cold and miserable the weather was during the summer. More than twice the normal amount of rain fell during July while the average temperature, 18° C, set a record low for the month. The weather continued to be wet and cold throughout August and September as well.

For most lakes, differences in chlorophyll concentrations and water clarity from the previous year were minor and probably not statistically significant. For other lakes, changes in productivity were detected that might have been the result of the unusal summer weather.

Higher chlorophyll concentrations and reductions in water clarity were evident in Black, Buck (South Bay), Crowe, Farren, Lower Beverly, Shawenego, Troy and Twin Sister Lakes. Above normal amounts of rainfall and runoff may have

increased the supply of nutrients available for algal production in these lakes during the growing season.

On the other hand, in some of the normally more productive lakes, increased inflow and runoff may have diluted the nutrient pool rather than augmented it. Water quality in Hay Bay, Moira, Muskrat, Stoco and Upper Rideau Lakes was better than it was 1991. The internal supplies of nutrients by resolubization from bottom sediments may be a more important source during the summer months than external supplies. Their productivity may be more limited by water temperature and the amount of sunshine than by nutrient concentrations. Some of these lakes experienced their best water clarity ever in 1992.

Classification of lakes

Lakes are classified on a continuously rising ***trophic*** (nutrient enrichment) scale according to their biological productivity. Traditionally, ***trophic*** state classification involves narrative descriptions of various factors and manifestations of enrichment such as nutrient concentrations, water transparency, profiles of dissolved oxygen with depth, the frequency and intensity of algal "blooms", plant and animal communities and even the physical dimensions of the lake itself. At the nutrient poor end of the scale are *oligotrophic* (unenriched) lakes and at the high end, *eutrophic* (enriched) lakes.

Oligotrophic lakes are characterized by low levels of chlorophyll and exceptionally clear water. They are usually deep lakes (more than 30 m). The shoreline is sparsely populated with aquatic plants. A stable fish population, often lake trout, provides a fair angling catch. The lake is well suited for a wide variety of recreational pursuits.

In contrast, ***eutrophic*** (enriched) lakes are more productive with higher concentrations of phosphorus and chlorophyll and poorer water clarity. Typically these lakes are shallow (less than 10 m) and often weedy and muddy. Fish populations do not include lake trout but may contain other sports species such as pickerel and bass. Angling success is generally better than for *oligotrophic* lakes since a more productive lake can sustain a larger population of fish. There is a good probability of one or more algal blooms developing in late summer or early fall. Under conditions of advanced *eutrophy*, the lake may experience recurring blooms throughout the growing season.

Mesotrophic (moderately enriched) lakes occupy an intermediate position in the classification scheme. They are intermediate with respect to depth, chlorophyll concentration, water clarity, and weeds. They may contain both warm and cold water fish populations.

While changes from *trophic* state do not occur at sharply defined stages, numeric criteria are useful in giving dimension to this classification scheme. Mean values for Secchi disc visibility depths and chlorophyll concentrations can be used to compare the lakes with more than 6 sets of observations from table 1 and to rank them according to their nutrient enrichment or *trophic* status.

Table 2: Ministry of the Environment Secchi disc - chlorophyll Lake Enrichment Classification Scheme.

Enrichment Status	Secchi disc (m)	Chlorophyll (ug/L)	Number of lakes
oligotrophic	>5	<3	14
mesotrophic	3 - 5	3 - 6	70
eutrophic	<3	>6	8

Lakes with less than 6 sets of observations are excluded from this table.

The simple allocation of a lake to a *trophic* state category based on solely one parameter may be of limited value.
A lake that is classified as *oligotrophic* by its Secchi disc visibility may show signs of *eutrophy* based on other characteristics. For the purpose of the above table, a body of water was classified as *oligotrophic* only if both the mean Secchi disc depth was greater than 5 metres and the mean chlorophyll concentration less than 3 ug/l. Similarly it was classified as *eutrophic* only if the mean Secchi disc depth was less than 3 metres and the mean chlorophyll concentration was greater than 6 ug/L. All other lakes were classified as

mesotrophic. In this way, the results of the 1992 Self Help water quality monitoring program indicate that 14 water bodies are *oligotrophic* and 8 are *eutrophic*. The remaining 70 lakes are categorized as *mesotrophic*. A comparable distribution of lakes amongst the *trophic* state categories has occurred in previous years. Lakes that are borderline between categories may change classification from one year to the next owing to slight changes in their water quality between years. Stoco Lake and Muskrat Lake which were classified as eutrophic lakes in previous years fell into the mesotrophic category in 1992 based on lower chlorophyll concentrations and improved water clarity.

Classification as *eutrophic* does not necessarily imply use impairment. As indicated above, use impairment is more closely related to the frequency and intensity of algal bloom occurrences than by seasonal average chlorophyll concentrations or Secchi disc visibility depths.

Many *oligotrophic* lakes are gems of pristine beauty that offer little recreational opportunity beyond swimming and boating. Some *eutrophic* lakes are extremely valuable because of their ability to provide excellent fishing.

LAKE PROTECTION

The Province has the responsibility to ensure the proper management of the resources that we jointly share in Ontario including our provincial waterways. The Ministry of the Environment and Energy sets limits on the quantities and concentrations of wastes that can be discharged to lakes and rivers. It also regulates the design and installation of private waste disposal systems such as septic tank - leaching beds. In many parts of the province, the field inspections and final approval of sewage systems are handled by a local Health Unit.

The Ministry of the Environment and Energy also plays a proactive role in the protection of our waters through the process of land use plan review. Data provided through water quality surveys and the Self-Help Program have been instrumental in establishing guidelines for the capacity of lakes to accommodate shoreline development. This information is used by local and regional planning agencies in establishing land use policies for Official Plans and drafting zoning by-laws that regulate future lakefront development. The Ministry of the Environment and Energy and the Ministry Natural Resources have jointly issued a report entitled ***Inland Lake Trout Management in Southeastern Ontario***. The report recommends landuse and development

controls on 53 lakes to ensure the protection of water quality for the maintenance of a sustainable lake trout fishery.

Existing waterfront property owners can also take individual responsibility in protecting their lake and its environment. The following is a list of practices that can be adopted to prevent or remedy adverse impacts of residential use of shoreland. Most of these actions are intended to minimize additional nutrient inputs to the lake.

1. New cottage construction and septic tank systems should be set well back from the lake. This practice allows phosphorus in runoff and in leachate from tile fields to be absorbed by soil and taken up by vegetation rather than reaching the lake. Set-backs have the additional advantage of preserving the natural scenic beauty of the shore by preventing development from intruding unnaturally upon the lake.

2. Building site preparation and construction activities should be carried out in a manner that minimizes disruption to the soil and vegetation on the property. All areas that are exposed during construction should be replanted as soon as possible to prevent runoff and erosion.

3. Sewage disposal systems should be constructed and installed in compliance with Provincial Regulations and properly maintained. Septic tanks should be pumped out periodically to remove solids. If they are not pumped out the solids can clog the leaching bed and cause the system to back up. The area over the leaching bed should be left open to the sun and wind to encourage evapotranspiration. Protect the leaching bed from compaction by vehicles and traffic including snowmobiles. If foul odours are noticed or signs of excessive moisture and surfacing of water on the leaching field, contact the local Ministry of the Environment and Energy or Health Unit office for advice.

4. Practice water conservation to avoid overloading your sewage disposal system. Automatic dishwashers and washing machines use large volumes of water which can place a strain on leaching beds. Take laundry back to the city for washing and do dishes by hand in the sink. Automatic dishwasher detergents have a high phosphate content and their use at a cottage should be avoided.

5. The shallow, near-shore, "*littoral*" zone supports most of the plant and animal life in a lake. Disruption of any part of this ecosystem threatens the entire cycle of life in the lake. In particular, habitat for fish and

wildlife may be destroyed. A regulation under the Public Lands Act requires a permit from the Ministry of Natural Resources (MNR) for any shoreline work. This includes cutting weeds, stabilizing banks, removing rocks or stumps from the water, building a dock or dredging. The permit is free and application forms are available from district offices of the MNR.

6. Maintain a zone of natural vegetation (trees and shrubs) as a protective buffer between lawns and the lake or leave your entire lot in a natural state. If you must have a lawn do not over fertilize it as the runoff could contaminate your lakefront.

7. If shoreline of your lake has been cleared of its natural vegetation, have your cottage association join MAPLE (Mutual Association for the Protection of the Lake Environment), a volunteer organization that helps landowners naturalize their shorelines. For more information or a brochure on the program please contact MAPLE, P.O. Box 271, PERTH, Ontario, K7H 3E4.

8. Help to ensure the continued enrollment of your lake in the Self-Help water quality monitoring program. On many lakes, cottagers' associations have been instrumental in

coordinating self-help efforts and ensuring continuity of participation in the program. In addition to collecting scientific data on your lake, participation in the program helps to build an understanding of lake ecology and an appreciation of the importance of lake protective measures.

By adopting the above practices everyone can play a role in helping to protect and preserve the future of their lake.